

EDITORIAL ARTICLES.

THE RELATION OF IMPERFECT OR IMPROPER TREATMENT TO THE PRODUCTION OF NON-UNION AFTER FRACTURES OF THE LONG BONES.

Celsus (*De Medicina*, libr. viii., cap. x.) incidentally alludes to non-union of broken bones, thus : "When the bones happen not to unite, *because they have been often opened and often moved*, the method of cure is obvious." This teaching of the ancient author is repeated by the modern Malgaigne in his dictum that when union fails to occur, the treatment is most frequently to blame for it ; and both express the generally received opinion, lay as well as professional, that failure of union on the part of a fractured bone is *prima facie* evidence of neglect or improper treatment. P. Bruns, in his more recent treatise on fractures in the volumes of the *Deutsche Chirurgie* (Lief. 27, hælfte ii.), after the statement that delayed or non-union occurs in some cases of fracture notwithstanding the apparently unexceptionable conduct of the patient and correct treatment by skillful surgeons, adds that, "nevertheless, the *sole* cause of non-union is certainly often enough improper or imperfect treatment." The natural result of this doctrine is to expose every surgeon, in whose care a fractured bone has been in which union is delayed, or fails altogether, to the charge of malpractice and to a loss of confidence in his professional skill, if not to a suit at law.

I propose in the following pages to inquire to what extent general experience corroborates the above given opinions ; or, in other words, to inquire whether the occurrence of non-union after fracture is presumably an evidence of imperfect or improper treatment.

It is doubtless true that in the history of very many cases of ununited fracture, defective immobilization can be proven to have been

present. On the other hand it is equally true that in an immense number of instances gross defects of immobilization are common without interfering with the steady consolidation of the fracture. Such are fractures of the ribs and of the clavicle in general, and a large proportion of fractures of the humerus and of the femur. Gunshot fractures of the shaft of the humerus in a marked degree present obstacles to securing adequate immobilization in their treatment, especially in the field in time of war, and yet, out of 2900 cases of shot fracture of the shaft of the humerus treated expectantly, as recorded in the Medical and Surgical History of the War of the Rebellion, in six only did non-union result. The only case of delayed union after fracture of the clavicle which I have yet met with was in the case of an apparently robust young man, in whom unusual care to immobilize the fracture had been taken by the surgeon under whose treatment he had been, by the application of a plaster bandage. Nevertheless, at the end of four weeks, when I first saw him, no callus had been thrown out, and the fragments were as movable as if the fracture had just been sustained. Under my advice all dressings were discarded, and the patient bidden go to work. At the end of two weeks he returned with an abundant ossifying callus uniting the fragments.

The frequency with which false joints have developed in fractures occurring among sailors on shipboard, who, in some cases, are many weeks without receiving skilled attention, has been noted (Norris, Curling, Harrison, Bruns), and these cases have been considered as illustrative of the effects of lack of immobilization, particularly as in many instances consolidation took place under proper hospital care after reaching port. No consideration of these cases can be complete, however, without taking into account also the defective hygiene of such sailors both before and after injury, the character of their diet, their crowded and imperfectly ventilated sleeping accommodations, and their long confinement on shipboard, all of which tend to create constitutional conditions not conducive to repair of injuries of any kind.

The frequent failure of passive and active movements to prevent ankylosis at the elbow, for instance, after excision of the joint surfaces, the invariable repair of fractures of the lower extremity of the radius in

which that fracture receives no treatment at all, the healing of fractures of the ribs and of the clavicle, these all are, doubtless, due to the extent and activity of the nutritive processes in the cancellated tissue involved in the injuries named. The dense compact tissue of the shaft of the humerus or the femur presents conditions less favorable for nutritive activity than the parts just mentioned. It is to be expected, therefore, that whatever causes, local or general, may be present in an individual case, tending to lessen reparative energy, would be more likely to determine absolute failure of repair in these bones than in others. The relative proportion of such failures may be calculated from the statistics of Bruns (op. citat., § 4 and 413), which includes 19,455 fractures of the arm and forearm, thigh and leg. From the figures given by this author I find that, if the relative frequency of non-union after fractures of the bones of the forearm be taken as the unit of comparison, non union in fractures of the bones of the leg is three times as frequent, and of the femur and humerus each six times as frequent, the proportion of cases of non-union to the entire number of cases of fracture of the particular bone being nearly the same in each of these two last named bones.

Granted, therefore, that fractures of the shaft of the femur and of the humerus are more frequently followed by non-union than those of other bones, and that the construction of the tissue of these bones is such as to render them more powerfully affected by any causes that tend to hinder repair, the question recurs, ought defects of immobilization to be considered as the *sole* cause of arrest of repair in any considerable proportion of cases? From the sphere of this question I would exclude cases of exaggerated neglect and intentional free movements of fragments. The question of defective immobilization in most of these cases has simply to do with the thoroughness of attempts at reposition of the displaced fragments and their retention by sufficiently efficient apparatus, of extension and counter-extension, the use of this or that kind of retentive apparatus, the inclusion or non-inclusion of neighboring joints in the immobilizing appliances, and such like matters. Certainly in the great majority of cases the results of such imperfect treatment are limited to the production of excessive callus, to

deformity and shortening of the bones. That in some cases where immobilization has been incomplete, non-union has resulted does not necessarily imply that this result was due to the defective immobilization. Very pertinent to this point is the testimony of Girdner (*ANNALS OF SURGERY*, 1887, vol. vi., p. 30) that in the treatment of fractures in insane patients, whose restlessness made it difficult to properly adjust and immobilize the fragments, he was always able to obtain bony union, except in cases of general paresis, in which class of patients, although they were, as a class, more manageable than patients with most other forms of insanity, osseous union was the exception, and greatly delayed union, soft fibrous union, or more frequently, complete non-union was the rule.

May it not be that in a much larger proportion of cases than has hitherto been acknowledged a more severe inquiry would elicit other causes, either local or constitutional, to which the non-union could be properly referable, rather than to the defective immobilization. The observations of Macewen as to the agency of a leaflet of the torn fibrous capsule of the patella, by becoming interposed between the fragments in cases of fracture, in producing the failure of bony union which is common after fractures of that bone, are suggestive that similar strips of periosteum may become torn up and interposed between fragments, and interfere with union in fractures of other bones more frequently than has hitherto been recognized. In a case of compound comminuted fracture of the humerus recently under my care, I found large fragments entirely stripped of their periosteum, and it is easy to conceive of the stripping up of portions of periosteum to a less extent in less severe injuries, and yet sufficiently extensive so that, by their entanglement between the fragments, union may be delayed or entirely prevented.

As to constitutional causes, Otis quotes Neudörfer as explaining the rarity of non-union after gunshot fractures of the humerus by the statement, "Pseudarthrosis, as a rule, is an evidence of a constitutional disease of the blood, which, among soldiers generally, and especially at the years in which they take the field, is rarely to be found." Bruns, again, in speaking of the etiology in general of non-union of fractures,

declares "that the cause of pseudo-arthritis remains entirely undiscoverable in very many cases;" and Packard (*Internat. Encyclop. Surg.*, iv., 43) states that non-union "may occur under the best treatment, and in persons seemingly of good health."

If then constitutional conditions indisputably determine non-union in many cases, and in the vast majority of instances defective immobilization fails to prevent union, it is more reasonable to refer failure of union when it does occur, even in those cases in which the immobilization has been defective, to the coincidence of constitutional causes, however difficult of demonstration, rather than to the defective treatment. It is easy to conceive, also, of cases in which the reparative energy of the tissues is weak, but in which, nevertheless, repair would ultimately take place under favorable conditions. In such cases defects of immobilization in the early history of the case might be sufficient to overwhelm the feeble local reparative power, and determine ultimate absolute non-union. But even in these cases the treatment is only one of the causes that have produced the result.

Constitutional conditions, if they exist, tending to retard the union of fractured bones, should declare themselves in more than one bone in the same individual if multiple fractures coexist, or if different bones were fractured at different times, unless, indeed, it be claimed that the constitutional state was a temporary one, as is undoubtedly the case in some instances, as from pregnancy, scurvy and certain acute diseases. I can cite from my personal observation two cases bearing upon this point. The first was in the person of an apparently healthy young man, 25 years of age, who sustained a fracture of the right femur, through the upper part of the middle third, from a fall from a wagon upon frozen ground. Some years before he had fractured the other femur; after due treatment for the usual length of time for that former fracture, he had resumed use of the limb, which was apparently healed, but a gradual bending of the femur at the site of the injury followed, until a **N**-like bend had been produced, which caused an unsightly and prominent projection upon the front of the thigh, and shortened the limb more than three inches. In this position full consolidation finally took place. The new fracture which

came under my care likewise apparently did well under ordinary treatment, and by the ninth week he began to walk upon it. Three weeks later the firmness of the union was still apparently satisfactory, but a slight outward curvature at the upper part of the thigh was noticeable. The shortness of the opposite limb caused a manifest strain to fall upon the newly united femur at this point in walking, and accounted for the bowing which had taken place. Though crutches were advised, the bend continued to become more marked. I lost sight of him for a time, but at the end of seven months, he returned to me, the outward bend at the site of the fracture being very marked. I now had constructed for him a modification of a common hip-joint extension brace, whereby the limb was kept extended, the weight of the body in walking was supported by a perineal crutch, and a broad band of elastic webbing was made to exert constant inward traction at the point of bending. Rapid straightening of the limb was effected by this device, with the result of lengthening it two inches. At the end of a month the femur had regained its natural direction. He was dismissed with the injunction to continue the brace for a time. His after history I do not know. The point of interest about this case in this connection is the existence of a constitutional condition in an apparently healthy young man which at two different periods, some years apart, occasioned delay in firm ossification of a fractured femur.

The second case was in the person of a robust mechanic who at one time sustained a fracture of his left leg. Under the usual treatment of support and immobilization union was still delayed at the end of 16 weeks. He was then encouraged to use the limb, with the support of proper splints, and, gradually, as he continued to walk upon it, consolidation took place, though with considerable deformity. Twelve years later, at the age of fifty, he fractured his left humerus at the junction of the lower and middle thirds. Though under skilled treatment from the first no union took place, and a typical pseudarthrosis developed, as was demonstrated in the course of an operation for its relief by myself three and a half months later. The oblique ends of the two fragments, though held in close apposition to each other by a capsule-like envelope of dense fibrous tissue, were each covered with a

thick well formed fibrous layer. My operation at that time consisted in the removal with a saw of a thin slice from each end, and then wiring the two refreshed bony surfaces together. Again no union took place. At the end of five months more, the general health of the patient being good, the site of fracture was again exposed, the loosened wires removed, the ends of the bones, which were bare and devoid of any appearance of reparative power, were thoroughly scraped, as was also the whole cavity among the soft parts in which they lay. The wound was not closed, but simply stuffed with a sterilized sponge dusted with iodoform, the whole covered with some absorbent material; a side splint completing the dressing. This second operation was more beneficial than the first. Abundant callus was thrown out about the ends of the fragments, and especially in the territory occupied by the sponge. The consolidation rapidly became so firm that the man was able to resume his work; but, nevertheless, full ossification was retarded, for at the end of three months slight lateral bending could still be impressed upon the bone at the seat of fracture.

In conclusion, I wish to say that, from the considerations which I have attempted to present in the preceding paragraphs, I am led to the conclusion that there is room to question the soundness of the teaching that imperfect immobilization is *often* the sole cause of non-union, or even the chief cause thereof. It seems to me rather that the weight of evidence is such as to justify the assignment to constitutional states, and to local conditions not within the control of the surgeon, a yet larger role in the etiology of pseudarthroses than is generally recognized.

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A MODEL OPERATING THEATRE AND ITS FITTINGS.

There must be many readers of this journal who would value greatly the opportunity of traveling over the continent of Europe and studying carefully the construction and arrangements of the operating theatres which have, in recent years been constructed with a special view to the practice of the most rigorous antiseptic surgery. For various and different reasons most of us are unable to make this instructive